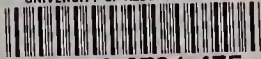


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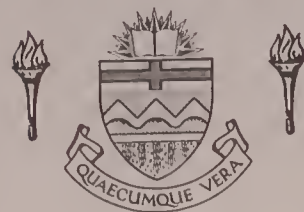
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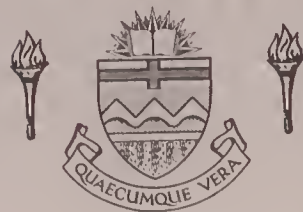
discovery studies series



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The Vancouver Environment Education Project is a cooperative project between the schools of B.C. and The Western Education Development Group in the Faculty of Education at the University of British Columbia. The materials are developed by teachers using the facilities of the Vancouver Environment Education Center. The project is directed by Dr. Kip Anastasiou. V.E.E.P. is prepared to provide substitutes for teachers who need time to research and formalize ideas for curriculum suited to Canadian schools.

V.E.E.P. has been supported by The B.C. Forest Service, Cominco, the B.C. Department of Education, B.C. Hydro, the McLean Foundation, the Manpower and Immigration Local Initiatives Program, the Leon and Thea Koerner Foundation, and the Justice Development Commission. It operates with the cooperation of the B.C. Teachers' Federation and various school boards.

V.E.E.P. is dedicated to the development of educational materials related to the Canadian environment. It is a broadly based interdisciplinary project. Although most of the materials are designed to provide elementary school teachers and children avenues of exploration on a continuing basis in the environments which make up their real world, an active programme of curriculum development for secondary schools is under way.

Co-operating Schools: Queen Elizabeth Annex, Cook School Annex, Norquay, University Hill, Bayview, Selkirk, McCorkindale, General Gordon, Southlands, Carnarvon, Begbie, Oppenheimer and Henderson Annex of Vancouver; St. Jude's of the Catholic Schools; Cypress Park of West Vancouver; Thrift Elementary, Matthew Elementary, Dr. Sinclair Elementary and Newton Jr. Secondary in Surrey; Argyle Secondary in North Vancouver; McNair High School and Hugh McRoberts Jr. Secondary of Richmond; Eagle River Elementary-Secondary School of Sicamous; Comox Jr. Secondary School, Courtenay District; Nanaimo Sr. Secondary School, Nanaimo District; Mountain View Elementary School, Como Lake Jr. Secondary School, Mary Hill Jr. Secondary School, George Pearkes Jr. Secondary School, Montgomery Jr. Secondary School, Sir Frederic Banting Jr. Secondary School, Moody Jr. Secondary School, Winslow Jr. Secondary School and Sunny Park School of Coquitlam.

Curriculum Associates: Wendy Stockstad, Hilary Strath, Tom Purakal, Joan Fefferman, James Gibb, Susan Infanti, Julia Kamm, Ron Miller, Arlene Offer, Victoria Tercias, Cathy Henry, Pat Woolsey, Mike Hoebel, Eve Alexander, Anne Nesbitt, Wendy Twining, Cindy Barrett, Kathy Brunner, Martin Conder, Melissa Hadley, Heather Harris, Liz Bowen, Duncan Ascough, Paul Bailey, Leslie Baker, Ken Borkowski, Gordon Calderwood, Frank Heyman, Helen Smith, Bob Sigstad, David Williams, Ed Korbin, Jim Stevens, Eric Tsang, Doris Potts, Dennis Flesher, Deryck Holdsworth, Doug Ante, Louise Ritchie, Mollie Byrne, Neil Dyck, Dot Palmarche, Jim McLaren, Sue Gibbs, Mark Gibbs, Rob Inrig, John Hoovèr, Peter Beckett, Ingrid Carley, Reiner Specht, Peter Napper, Elaine Mascali.

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the jolly green classroom

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INTRODUCTION

Many classrooms contain growing plants which are situated around the room to help create a pleasant atmosphere and provide students with materials to observe and care for. The use of growing things in the classroom can however, be extended to include an almost limitless number of "educational" purposes from art projects, to science experiments, to group interactions.

The purpose of this unit is to provide suggestions, techniques and starting points which will allow teachers and students to make more effective use of plants in the classroom. The unit presents starting points for investigations into various types of plant propagation, soil properties and seeds, as well as a number of art and craft projects for classroom and takehome use. The unit also provides suggestions for the creative recycling of such one-way articles as styrofoam cups, plastic bags, milk cartons, tin cans, plastic bottles and aluminum foil trays. In this way students are introduced to the concepts of "producer" and "consumer" while at the same time they are able to enjoy an active involvement with living materials. Activities in the unit are suitable for elementary children however not all activities are suitable for primary or intermediate students exclusively.

A. SEEDS AND SOILS

1.. All Sorts of Seeds

Children are always fascinated with growing things, particularly if they are in some way responsible for the growth that is taking place. A good place to let this begin is with a series of activities and investigations involving seeds. Seeds are only one means by which plants reproduce but they are the

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most familiar method to most students. Begin your activities by having students go outside and collect, or bring to school as many different types of seeds as possible. The resulting seed collection can provide starting points for a large number of activities. Depending on the ages and abilities of the students involved, these activities could include the following:

Classification: Seeds can be classified in many ways; size, shape, colour, type of plant, texture, or method of dispersal are but a few. Have students classify seeds in as many ways as possible. This can be made into a learning game by having students try to guess the "laws" which govern the classification done by others. e.g. Have students classify seeds then try to determine the rules which other students used to sort out different groups of seeds (size, shape, colour, etc.).

Order and Seriation: Simple ordering or seriation of seeds from large to small will help younger children to learn this task, cover concepts such as biggest and smallest, as well as impress the child with the range in size of seeds.

Art Projects: Many seeds lend themselves well to use in art projects because of their form, colour, texture or shape. Challenge your students to make a "seed picture" using only seeds, paper and glue.

Measurement and Numbers: Have students find plants that produce one, ten, one hundred, one thousand and one million seeds then challenge them to prove it. Students can also be challenged to find ways of weighing seeds or measuring how far seeds can travel from the parent plant. Have students work on problems like: How many seeds in a gram? In a kilogram? In a cubic centimeter? In a litre?

Diversity: Have a "Seed scavenger Hunt" and list items such as:

1. 2 different "flying" seeds.
2. a small seed from a big plant.
3. a big seed from a small plant.
4. 100 seeds all the same.
5. a seed that can't be seen.
6. a seed that floats and one that sinks.

2. Growing Seeds

FOR YOUR INFORMATION

For investigations involving the process of germination it is best to use fast germinating seeds such as mustard or radish (both will begin to germinate within 24 hours), and large seeds such as beans or peas (these will germinate within 2 or 3 days).

Students do not necessarily need to know the parts of a seed by name as they will be able to complete these investigations without them.

a) Pull a Seed Apart (5 or 6 seeds per student)

Use the largest seeds available (broad beans are excellent) soak the dried seeds for at least 14 hours (overnight). Have students carefully pull one of their soaked seeds apart in order to see how many parts their particular seed has.

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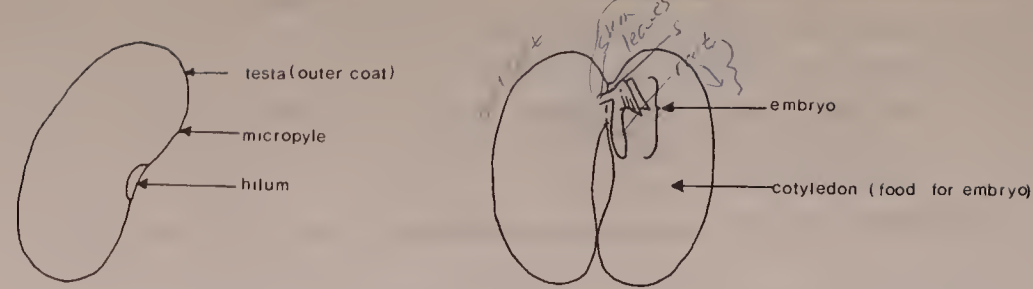
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Parts of a Bean Seed (Dicotyledon)



Ask students to suggest a function for each of the parts which they find then ask them if there is a way that they could prove whether they are right or wrong. Some students may wish to compare their type of seed with others so it is a good idea to soak a number of different seeds in advance.

Seed Soaking

Soaking seeds in water is in effect, a method of starting the "motor" of each cell in the embryo. During storage the cells are in a state of semi-dehydration and are not metabolizing. Addition of water swells each cell and starts up its metabolic motor allowing rapid cell division to take place.

Have students place their remaining seeds around the inside of a drinking glass, or glass jar then hold them in place with moist paper towels. Every day or two, students should pull another of their seeds apart in order to note

changes in the germinating seeds. Again, some students will wish to compare the germination of several types of seeds and provision should be made for these students.

b) Grow a Weed Garden: Many of the seeds that students will collect fall into the category of weeds. Have students plant some of the seeds that they have collected in a fertile sandy loam (see page 8). The resulting "weed" gardens will, in many cases, be surprisingly aesthetic. Students may wish to investigate possible uses for weeds

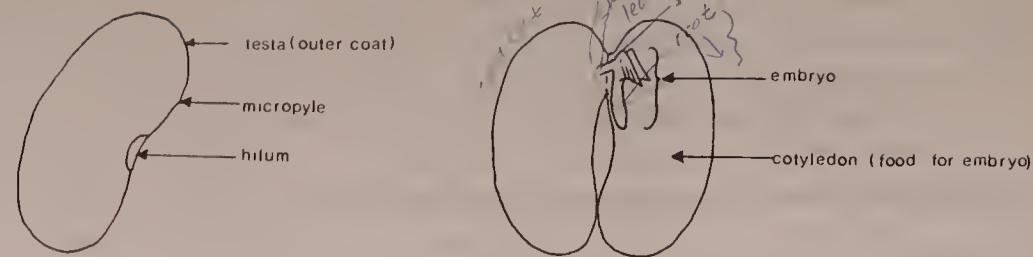
after a discussion of what attributes constitute "weedliness". Some students may wish to become "weedologists" and specialize in certain types of weeds. For example, the oft maligned dandelion is an undesirable pest in a well manicured lawn but a meadow full of dandelions is quite a pleasurable sight. A dandelion "specialist" might be surprised to discover the wide variety of dandelion species which exist in B.C. Such studies could lead to investigations of specific topics by groups or individual students.



c) Grow a Graph

Have a group of students plant seeds in a series of similar containers at three or four day intervals. (Time the intervals to miss out weekends.) As the seedlings grow, a living graph of the growth of the particular plant will be produced. Students may be instructed to graph the growth in as many ways as possible, including picture graphs, bar graphs and line graphs. Graphing studies can lead to additional investigations such as: find the

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effect of plant food, light, water or temperature on the "growing graph" of a particular type of plant.

Weekend Worries

Many plants and particularly young seedlings, are liable to wilt or die if left unattended in an arid classroom over the weekend. Rather than searching for volunteers to take plants home over the weekend, the problem can be solved by providing each plant with its own plastic bag greenhouse. Larger greenhouses may be made from such materials as coat hanger wire and dry cleaning bags and can occupy a table or side board in the classroom

3. Soil Studies

Land plants occur in an almost infinite variety of shapes, forms and species but often their outward appearance (shape, size and form) is regulated by the type of soil in which they grow. Students often overlook the role of soils in their daily lives yet most of the world's food supply is in some way dependent on the top six inches of topsoil on the earth's farmlands. (only 10% of the earth's surface is suitable for farming).

A good way to begin soil studies is to plan a field trip near your school to look at and obtain samples of different kinds of soil, perhaps one "good" soil and one "bad" soil. Try to select some areas for your field trip where soil conditions are radically different from other areas. Places such as bogs, swamps, marshes, woodlots, flower beds, vacant fields, hill-sides and valley bottoms will provide soils which are noticeably different from each other. On a small scale soils from beneath large trees may be

compared with soil a few yards away in an open area or soil from a flower bed may be compared with soil from a footpath. As students are collecting and examining soils in the field have them note the plants which are growing in the soil which they are collecting. Here are some soil studies for indoors and out:

- a) What is soil?: Provide, or have students collect samples of various kinds of soil. Through the use of hand lenses or dissecting microscopes have students "dissect" their soil in order to list its constituents. Students should look at individual constituents such as sand, rocks, clay and organic matter (anything which was once alive) as well as the physical properties of the soil itself. i.e.: Is it lumpy? hard? soft? black? grey? loose? compact? etc. Using this type of criterion suggest that students compare good soils with bad soils in order to make a "recipe" for a "good" soil.
- b) Manufacturing soil: Once students have considered the properties of soils in general, challenge them to make some soil from raw materials.

Raw Materials

Students should be able to discover most of the normal constituents of soil from a careful examination of soil samples. This does not mean that soil "recipes" should be restricted to naturally occurring substances. A typical soil recipe might include styrofoam chips, vermiculite, shredded newspapers or bits of old rags, as well as sand, peat moss and compost.

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Each student or group of students could try at least two "recipes" and compare their results. Soil recipes can be tested by growing radishes, weeds or other readily available seeds in each soil and comparing the results. Some students in the intermediate grades will benefit from a discussion of controlled experiments and may even wish to test soils using this method.

Good Soil

Gravel soils, sandy soils, and clay soils are all named by their major constituent and all have deficiencies in terms of suitability for plant growth. The best possible soil is a mixture of equal parts of clay, sand and humus called loam soil, or loam. Loam has all of the good qualifications of other soils (moisture retention, minerals and aeration) without any of the bad points.

c) Cultivating: Have students investigate some of the effects of cultivation in natural situation. Simple physical alteration of the soil in places such as a well worn footpath can produce quite rapid changes. The growth of many plants, including weeds, is often restricted by competition from other plants. Students can investigate this effect simply by removing competing plants from an area (a practise commonly known as weeding). Students may wish to investigate competition by purposely crowding plants in one container and comparing them to purposely uncrowded plants in another container.

d) Why does it grow here?: Certain plants are adapted to soils with a particular quality such as acidity, moisture or temperature. Students can investigate these types of phenomena by transplanting plants from one soil type to another or by altering the soil around a particular plant. Alterations might include construction of drainage ditches, or the addition of fertilizers, lime, peat moss, sand, sawdust or clay.

B. GARDEN TOOLS AND CONTAINERS

Many science units intended for the elementary school are avoided because of the cost and complexity of the materials involved with each "kit". The cost of gardening materials could also become prohibitive if they were all purchased from a local garden shop. However, many enjoyable and productive hours can be spent gathering and constructing useful gardening items from materials normally classed as garbage.

Sort out the Garbage: Detour on a One-Way Street

- a) Have students suggest and collect as many different types of one-way containers as possible.
- b) As the class collection of containers grows, start a discussion about one-way containers including items such as the source (resource) of the raw materials, the intended use and other possible uses.
- c) Some students may wish to classify a garbage collection in order to show where various products originate (forests, petroleum, etc.) what their actual life span is (do they decay?) and what part of their life span is intended to be useful? (e.g.: what percentage of the time from its manufacture to its

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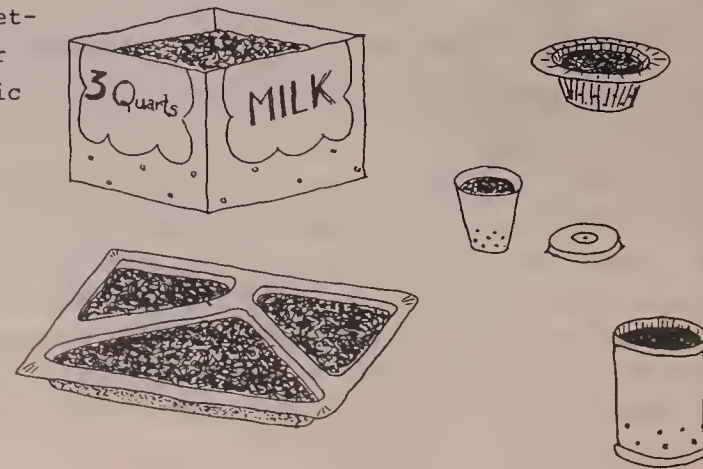
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d) Other students can be challenged to suggest, design or actually construct useful items from garbage which has fulfilled its intended use.

Gardening with Garbage

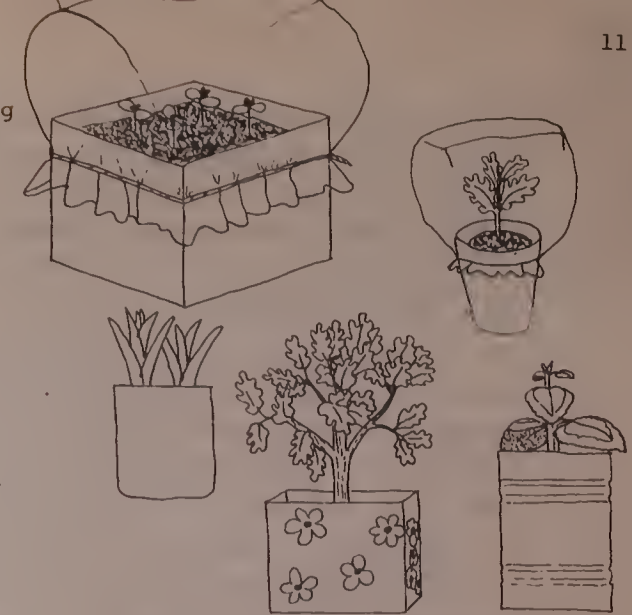
Most packaging items which were originally intended for use as containers can function as such for quite some time beyond their intended useful life span. Most of the containers used for classroom gardening will function as growing trays or plant pots but there is an endless variety of alternate uses limited only by the students' imagination. Here are a few suggestions for starters:

a) Seed Trays: Almost any containers can be used as a tray for the starting of seedling plants, but some of the better ones are those which have a lid or are easily covered with a clear plastic bag in order to retain moisture.



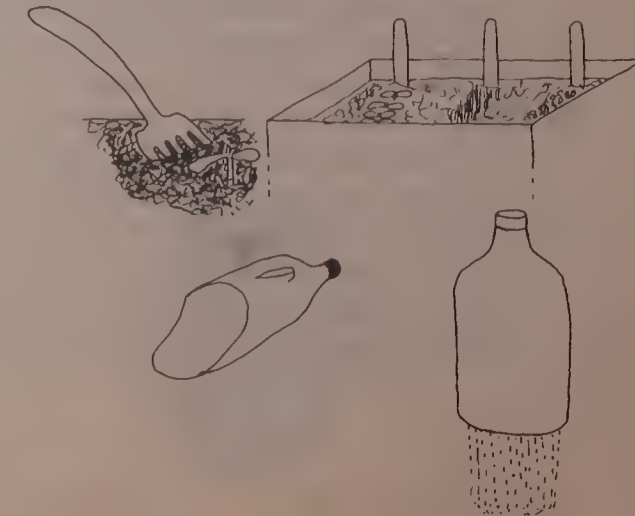
Note perforations for drainage.

b) Cutting Propagators: Ideally, the growing of cuttings requires two basic conditions; moisture and warmth from below. Cutting propagators may be made for individual cuttings or large numbers of cuttings as shown in the drawing.



c) Plant Pots: Containers for larger plants should be fairly sturdy and have one or more drainage holes cut in their base. Milk cartons, jam tins, plastic bleach bottles or soup tins are a few of the containers suited to this purpose.

d) Garden Tools: Making a watering can could be an all day project (e.g.: who can make an "automatic water can?") or simply a matter of poking some holes in an old plastic jug. Popsicle sticks make good name tags, seedling shovels or plant supports. Plastic forks or stirring sticks



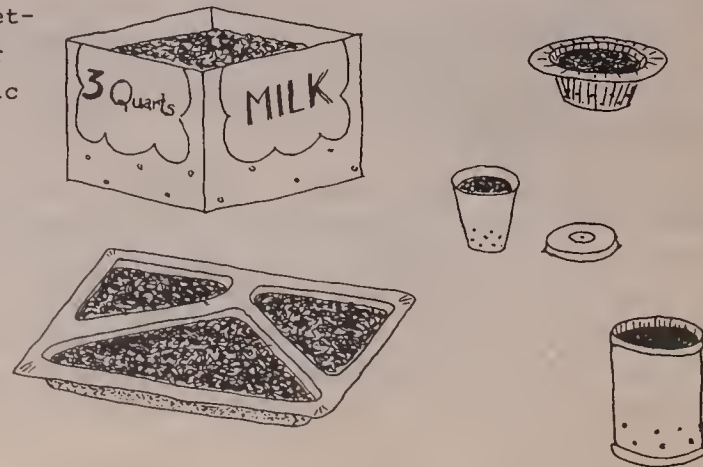
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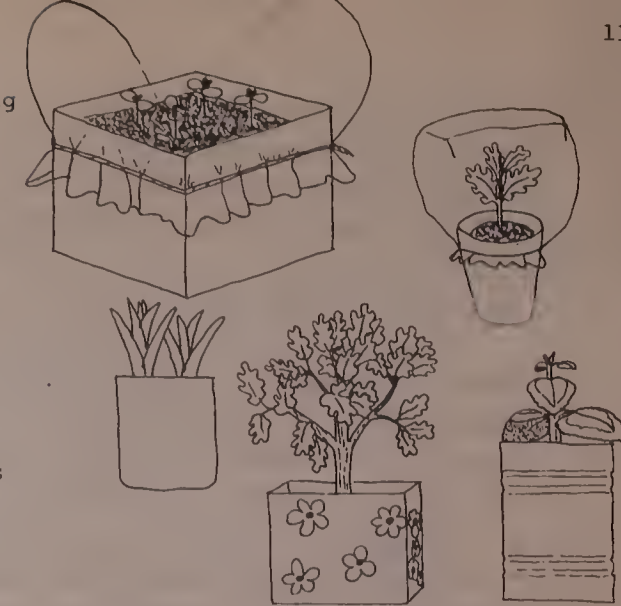
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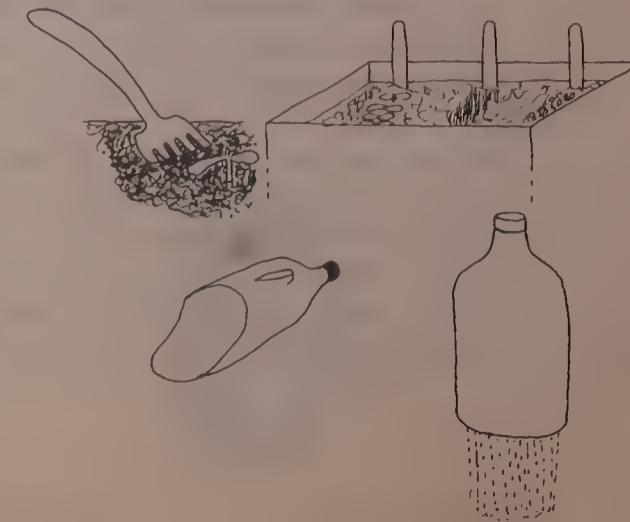


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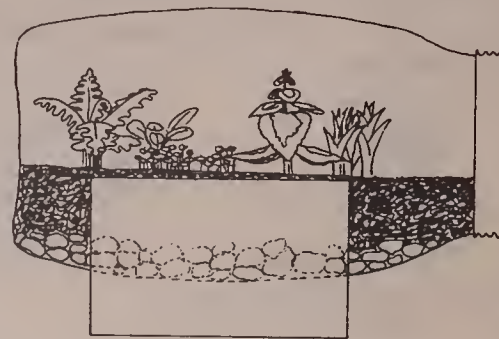
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also have good potential. Cut the end off a large plastic bottle and it becomes a scoop for peat, soil or sand. Plastic bags have an infinite variety of uses from storage containers and sheeting for mini-greenhouses to propagating chambers and compost makers.

C. ARTFUL GARDENING

A number of art projects can be quite successfully incorporated into a series of gardening type investigations. A completely enclosed terrarium can be aesthetically pleasing while at the same time leading to investigations related to plant respiration and transpiration or the needs of living things. Here are a number of artful gardening suggestions:

a) Terraria: A bottle or jar terrarium is an extremely simple task and can be a successful project at almost any grade level. Essential ingredients include sand or gravel, potting soil mixture, plants and a large jar or bottle (1/2 gallon size and larger are preferable). Sand or gravel is placed on the bottom of the jar for drainage purposes and the jar is then filled about 1/3 full of potting soil mixture; the Terrarium is now ready for planting. Plants which prefer high humidity are most suited to terrarium life and many plants such as mosses and ferns adapt readily. Many 'tropical' house plants are easily propagated by cutting and are also suitable for terrarium life. A



terrarium stand can be constructed from a half gallon or 3 quart size milk carton as shown in the diagram.

Gathering Wild Plants

Students should be encouraged to obtain plants for terrariums from their own home and yard as much as possible. Naturally occurring mosses and ferns are usually slow growing plants and their removal from the environment should not be encouraged. The same caution may be extended to wildflowers and other such plants; because of their delicate nature transplanting is rarely successful.

Some students may wish to grow exotic varieties such as Mimosa pudica (the sensitive plant) or the Venus Fly Trap and other carnivorous plants, all of which can do well in a Terrarium. Terraria do not require large air holes and in fact many survive quite well even though they are completely sealed off. Watering is almost an unnecessary task where terraria are concerned, however they should be protected from too much direct sunlight or they will rapidly become an oven.

b) Hanging Bottles: Many climbing plants exhibit a negative response to the force of gravity, (geotropism that is their growth is always in an upward direction. [This may



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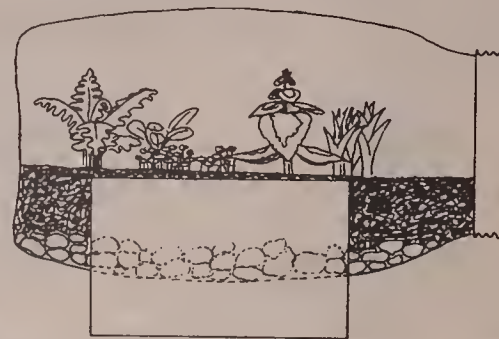
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also be caused by a positive reaction to light (phototropism)]. Because of this, plants such as Tradescantia and some forms of ivy are well suited for use in a "hanging bottles" project. Hanging bottles can be made from any bottle which has an interesting form or colour (wine bottles are probably the best). If the bottle is to be hung upside down, then several holes must be drilled in the bottom.

Drilling Bottles

To drill holes for a hanging bottle build up a small clay dam around the area where the hole is to be. Sprinkle some powdered carborundum (obtainable at most hardware stores) in the center of the well (inside the dam) and drill the hole with a piece of copper tube clamped in the chuck of an electric drill. This procedure should not be carried out by students of elementary age. Drill 2-6 holes of 3/8" or 1/2" diameter depending on the size of the bottle.

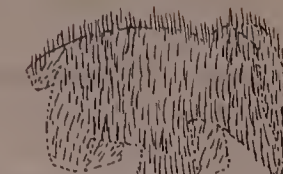
Fill the bottle 3/4 full with potting soil and place cuttings in the top or drilled holes. Make a wire or string frame to support the bottle then hang it so that the cuttings are upside down. In a few days the cuttings should begin growing upward and within weeks the bottle should be enveloped in foliage, giving the appearance of a plant growing in mid-air.

c) Sponge Gardens: Purchase, or have students bring sponges from home. Students may cut or otherwise shape the sponges as they wish, then wet the sponges and sprinkle them liberally with grass, weed or other types of seeds. (Bird seed mixes produce interesting effects). The sponge gardens may be

placed in a dish and kept moist through the addition of water to the dish. Alternatively sponge gardens may be suspended by a string and watered by allowing the sponge to soak moisture from a dish. Sponge gardens should be moved as little as possible during the first few days in order to allow the roots of the germinating seeds to take hold.



Sponge cut out



a "grassy mammoth"

d) Window Boxes and Hanging Baskets: Simple window boxes or hanging baskets can be made from large plastic bottles by simply cutting the bottle as shown in the drawings and decorating the container with felt pen, wall-paper, gift wrap or "mac-tac" cutouts. The project could be completed by planting the box or basket with student grown flowers, weeds or house plant cuttings.



e) Strawberries and Ivy: Large plastic bottles may also be used to produce a standing strawberry or ivy garden. Simply fill the bottle with soil, decorate the exterior then make several horizontal slits (about 3" long) in the side of the container. Push enough extra soil in to each slit to hold it open and plant strawberry plants, ivy, or other climbing plant cuttings in each slit.



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f) Scarecrows: A good project for a large group, or even an entire class, is the construction of a "Wind Activated Scarecrow". Using plastic bottles, milk cartons, tin cans, aluminum foil plates, styrofoam cups and any other items of garbage which students might suggest, have them construct a life size scarecrow with as many wind-activated moving parts as possible. If your school is in a rural or semi-rural area try to obtain the co-operation of some local farmers to provide testing grounds for scarecrows and other "wind operated pest deterrents".

D. BENDING AND BONSAI

Bonsai

A good reference for students interested in pursuing Bonsai as a project or hobby is the Sunset book Bonsai published by Lave Books, Melno Park, California and available at most book, hobby and garden shops in B.C.

Bonsai is an ancient Japanese art form in which small tree and shrub seedlings are pruned and trained to produce living miniatures of the full grown plant. Roots as well as branches are pruned to restrict growth and produce the desired shapes and forms. It is not possible to engage in actual Bonsai in the classroom because of the time involved in the production of a finished growth, however some students may wish to read up on Bonsai and perhaps begin a project on their own. The growth and form of plants is affected by many natural phenomena and many plant reactions (tropisms) can be easily investigated in the classroom. An introductory discussion of

Bonsai might lead to some of the following investigations on natural bending:

a) Light bending: Some students may notice that certain plants and seedlings in the classroom always seem to bend towards the windows. Have students investigate the effect of light on seedlings by shielding seedlings from light in all but one direction. Do the seedlings always grow toward the light? How does this bending help the plant?

b) Gravity bending: Have students tilt some seedlings on their sides and at various angles of the vertical. Do the plants grow in a new direction? Could they be responding to light? How can you find out?

c) Touch bending: Many common plants (e.g.: pole beans, peas, morning glory, ivy) will bend when they come in contact with a solid object. Some plants, such as peas, have specialized structures (tendrils) which "grab" onto things and bend around them. Have students grow some pole beans, peas, or climbing ivy and investigate this type of bending. Here are some starters:

- (i) Do the plants all bend in one direction?
- (ii) What happens when there is nothing to bend around?
- (iii) How big/small an object will the plant bend around?
- (iv) Can the bending be changed by light or gravity?

d) Other types of bending: Have students investigate other types of bending using bean, pea or radish seedlings. Here are some suggestions:

- (i) Will seedlings grow towards a magnet?

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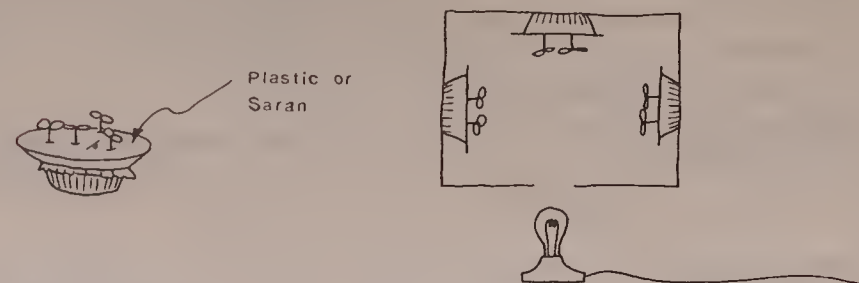
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- (ii) Which type of bending is strongest; light bending or gravity bending? (Have students place seedlings upside down in a box with light at the bottom).



- (iii) Will seedlings grow toward warmth?

E. PLANTING WITHOUT SEEDS

Many plants can be grown without the use of seeds and some students may wish to investigate different methods of growing plants. Here are a few suggestions for starting points:

- a) Tubers: Plants such as potatoes, yams and begonias can be grown from whole or cut up tubers (the actual potato) as long as the part to be grown contains at least one eye. Students wishing to grow potatoes should

make sure that their tubers have not been chemically treated to prevent sprouting.

- b) Corms: Garden flowers such as gladiolus and crocus are usually grown from corms which are often confused with bulbs. Have some students compare corms with true bulbs such as onions or daffodils to note the differences. Many corms will produce small "cormlets" which can be planted to produce new plants.

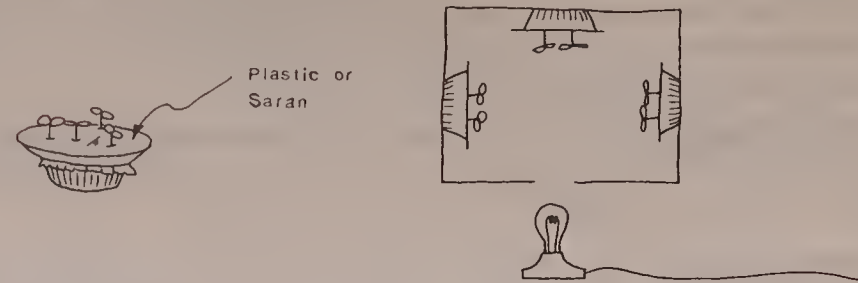
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- d) Cuttings: A large number of plants can be propagated from shoot cuttings. This process is described in some detail in section G of the unit (Page 27).

- e) Underground Stems and Tap Roots: Plants such as the iris or some of the ferns can be reproduced by cutting the underground stem or rhizome into smaller pieces. Carrots, turnips and beets can be grown by using all or part

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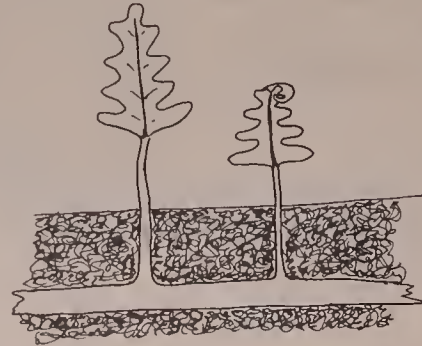
of their tap root. Have students hollow out part of an inverted tap root and suspend it from a string as shown in the diagram, keep the hollow filled with water and the results will be another type of "Hanging basket". (Note: Tubers are actually a form of modified rhizomes or underground stems).



Carrot



Turnip



underground fern stem

F. FOOD FOR THOUGHT AND FLOWERY IDEAS

Once students have become proficient at some basic gardening techniques, they will be able to engage in a number of more sophisticated growing projects. Group interactions and cooperation can be encouraged through the use of class projects which require small groups to work independently and yet coordinate their efforts with those of other groups. Here is a suggestion for one such project which can be an exciting learning experience capped off with a class luncheon.

Let's Grow a Salad:

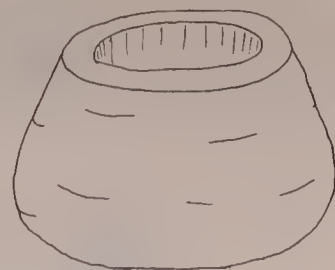
In January or February suggest to your class that they begin to plan for a class party to be held in the middle of June. Suggest that one of the main features of the party should be fresh vegetables and a salad, planted, grown and harvested by class members. Other items on the menu of such a party could include fresh baked bread as suggested in the VEEP unit Loafing Around with Bread (Pat Woolsey, 1973) or jams, jellies or other preserves which class members have picked and processed. It is necessary to begin preparations in January or February as the first plantings should begin by March 15th and groups will need time to organize. Discuss the possible salad ingredients then divide the class into groups and have each group select one or two ingredients which they will plant and care for. Set a date for the class feast so that each group can time their planting schedule in order to produce a simultaneous harvest of all the salad ingredients. Students should be encouraged to make as many of the necessary calculations as possible using some of the following suggestions as a guide:

a) Ingredients: Some or all of the following produce items can be successfully grown in the classroom, however if schoolyard space is available and vandalism can be avoided, many of the items are more easily grown outdoors.

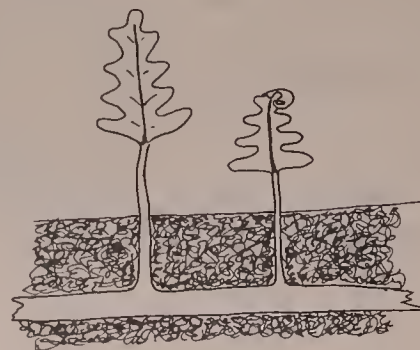
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<u>Vegetable</u>	<u>Suggested Varieties</u>	<u>Planting Date</u>
Tomatoes	Early Chatham, Victor	March 15
Green Peppers	Early Pimento	April 20
Radishes	Scarlet globe, icicle	May 15
Green Onions	Evergreen bunching	April 15
Peas	Laxton's progress	March 30
Carrots	Oxheart	April 4
Leaf Lettuce	Grand Rapids	May 1
Head Lettuce	Tom Thumb	April 20
Cucumbers	Burpee Hybrid	April 1 - 15
Mung beans (for bean sprouts)	* Must be purchased from a healthfood store or Chinese food supplier.	June 1

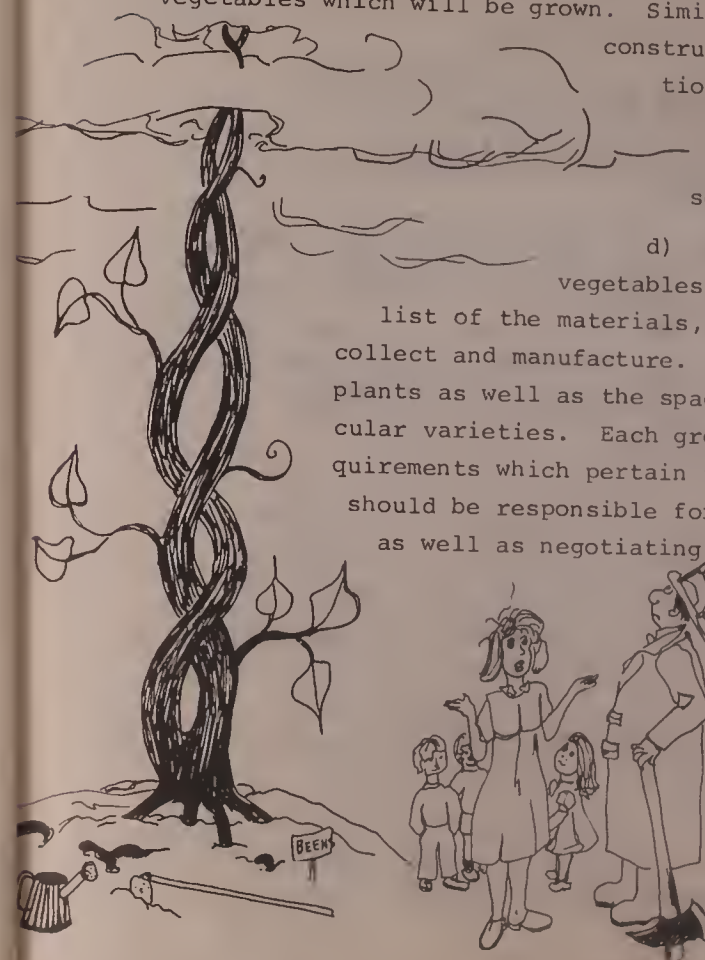
b) Time Schedule: Each group should be instructed to calculate a starting date and set up a schedule of care and observation for their plants. If several groups measure and graph the growth of their plants then comparisons can be made when the project is completed. Students should be able to note that the growing graph for many plants has a similar shape, yet some are quite different. Can plants be classified by the shape of their growing graph?

The planting dates given on the chart on this page are for a party scheduled for June 15 using the vegetable varieties suggested. Each group check the seed packages which they obtain in order to determine the length of time necessary for the production of mature vegetables from their seeds.

c) Spacing and Equipment: Groups will have to work together to decide on the best uses of available window space and make space and time allotments for all the vegetables which will be grown. Similarly each group will have to collect and construct all the equipment necessary for the production of their particular crop. If the class desires, one larger group could be designated as a materials and equipment group in charge of soil, containers, tools and fertilizers.

d) Preparation: When groups have decided on the vegetables which they wish to produce they should make a list of the materials, tools and containers that they will need to collect and manufacture. Consideration must be given to the size of the plants as well as the space and special requirements necessary for particular varieties. Each group should consult a reference for cultural requirements which pertain to the vegetables which they are growing. Groups should be responsible for listing and assembling all necessary equipment, as well as negotiating sufficient window space for their plants prior to the planting date which they have calculated.

e) During the Project: Measurement and observations can be emphasized as much or as little as necessary if each student in a group is asked to keep a diary of group activities and plant growth. Some groups will need more help than others and the teacher should try to ensure that students are not forgetting any necessary procedures or ingredients. Here is a



..And no one has even seen Jack since recess!"

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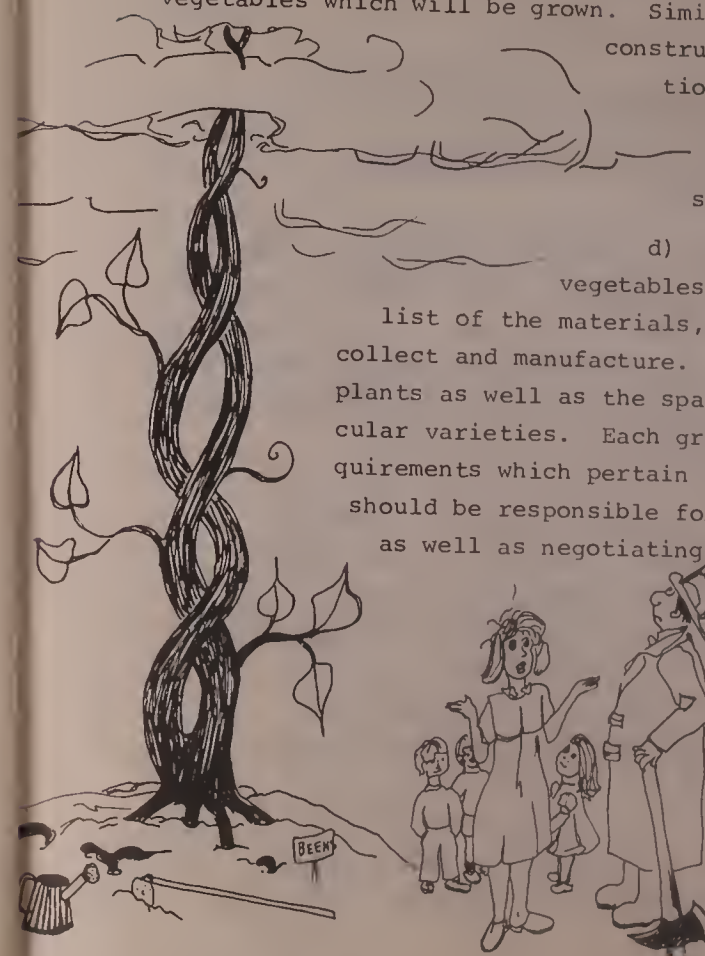
b) Time Schedule: Each group should be instructed to calculate a starting date and set up a schedule of care and observation for their plants. If several groups measure and graph the growth of their plants then comparisons can be made when the project is completed. Students should be able to note that the growing graph for many plants has a similar shape, yet some are quite different. Can plants be classified by the shape of their growing graph?

The planting dates given on the chart on this page are for a party scheduled for June 15 using the vegetable varieties suggested. Each group check the seed packages which they obtain in order to determine the length of time necessary for the production of mature vegetables from their seeds.

c) Spacing and Equipment: Groups will have to work together to decide on the best uses of available window space and make space and time allotments for all the vegetables which will be grown. Similarly each group will have to collect and construct all the equipment necessary for the production of their particular crop. If the class desires, one larger group could be designated as a materials and equipment group in charge of soil, containers, tools and fertilizers.

d) Preparation: When groups have decided on the vegetables which they wish to produce they should make a list of the materials, tools and containers that they will need to collect and manufacture. Consideration must be given to the size of the plants as well as the space and special requirements necessary for particular varieties. Each group should consult a reference for cultural requirements which pertain to the vegetables which they are growing. Groups should be responsible for listing and assembling all necessary equipment, as well as negotiating sufficient window space for their plants prior to the planting date which they have calculated.

e) During the Project: Measurement and observations can be emphasized as much or as little as necessary if each student in a group is asked to keep a diary of group activities and plant growth. Some groups will need more help than others and the teacher should try to ensure that students are not forgetting any necessary procedures or ingredients. Here is a



..And no one has even seen Jack since recess!"

short trouble shooting list to aid in spotting problems:

<u>Problem</u>	<u>Possible Cause</u>
Leaves turn yellow	too much water, or poor soil - use liquid fertilizer.
Leaves wilt	not enough water windows need shading.
Seeds fail to germinate or seedlings die off	"damp off" fungus attack, too much water, poor ventilation. Use a disinfectant on seeds (see page 31).
Plants spindly, pale green or yellow	not enough sunlight, or soil not deep enough. Place plants in larger container or nearer the window.

Flowery Ideas: Regardless of the variety of plants grown in a classroom whether they are garden flowers, vegetables or weeds, flowers will inevitably appear. Students may at first mistake budding flowers for the fruit of the plant as is often the case with bean plants, but they should be encouraged to make careful observations of flowers in order to determine the role that flowers play in the life of the plant. If several plants of the same type are in different stages of development at one time then drawings, dissections and comparisons are greatly facilitated (see page 5). Students should be instructed to follow the development of at least one type of flower for several weeks in order to discover what happens to the flower. Have students compare flowers and suggest reasons for differences and similarities in flowers.

Fun and Profit: Many flowers can be grown for classroom decoration or for take home projects on occasions such as Mother's Day, Father's Day or Christmas. Here are a few suggestions for flowery projects:

a) Corms and Bulbs: Many varieties of Crocus, Daffodil, Hyacinth, Galanthus (Snowdrops) can be grown in pots and "forced" to bloom indoors much earlier than they would outside. The best bulbs to use for forcing are pre-cooled bulbs which are available from some nurseries early in the fall. These are usually restricted to narcissus varieties and hyacinths. These varieties must be pre-cooled or frost treated as exposure to cold temperatures is necessary to trigger metabolic reactions which start the plant into growth. Some students may wish to experiment with some bulbs by refrigerating or freezing bulbs then planting them in containers for forcing. Some of the following questions may be used as starting points.

- i What temperatures are necessary to trigger various bulbs?
- ii How long must bulbs be kept cool before they can be forced?
- iii Can bulbs survive freezing temperatures? If so, for how long?

Many Daffodils and Hyacinths can be forced by following the procedures outlined below: (begin in fall or early winter)

- i Place bulbs in a cool refrigerator for 2 weeks
- ii Pot bulbs in containers which are at least 15 cm deep and have 4 cm of gravel on the bottom.
- iii Water the containers thoroughly outside in a cool shaded area and bury them or cover them with about 4" of sand or ashes. Leave for 8-10 weeks to allow good root development.

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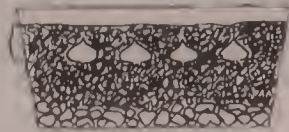
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v Bring the containers indoors to a cool area until shoots begin to appear then bring them into the warm classroom and set them near a window.

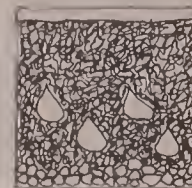
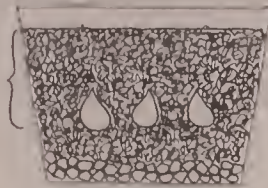
Bulbs Suitable for Forcing

Crocuses: Can be started in October or November for forcing in mid-January. Use shallow (8 cm containers).



Galanthus: Start in September for forcing in early November in time for Christmas. Use shallow containers.

Tulips: Start anywhere from September to November in deep pots. Keep outside until leaves and buds have appeared then bring indoors.



Daffodils and Hyacinths: Narcissus varieties such as Paper White and Grand Soleil d'Or are best for early flowers but must be pre-cooled. Most hyacinth varieties are suitable and do not require as much pre-treatment as Narcissi. Plant Narcissi and hyacinths in deep containers beginning in September and October. Hyacinths can also be grown by sitting them on top of a suitable glass jar so that the base of the bulb is immersed in water, this technique allows close observation of root development. (Note: onions are much cheaper if root development is the only consideration.)

b) Bedding Plants: Several bedding plants are fairly hardy and can be grown in the classroom with relative ease. These plants can serve as subjects for the observation and measurement of plant growth and flowering, as well as suitable take home projects which will be ready in May or June.

<u>Plant</u>	<u>Classroom Planting Time</u>
Marigold	April 1
Pansies	March 15
Sweet Peas	February 1
Viola	February 1
Nasturtium	April 1
Zinnia	March 15 - April 1
Geranium	Anytime (for indoor plants) March 15 (for outdoor plants)

If these plants are cared for and fertilized regularly, students will have some healthy plants, suitable for garden planting in May or June.

G. TECHNIQUES FOR CUTTINGS AND SEEDLINGS

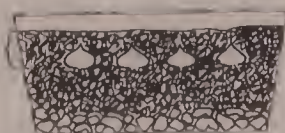
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The use of cuttings, where an actively growing part of an existing plant is cut and caused to form roots, has an advantage over plants grown from seed in that it produces good sized plants in a much shorter time. This is

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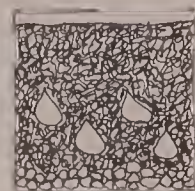
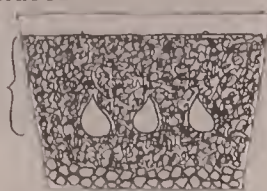
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The use of cuttings, where an actively growing part of an existing plant is cut and caused to form roots, has an advantage over plants grown from seed in that it produces good sized plants in a much shorter time. This is

especially valuable for use in Mother's Day, Easter or Christmas projects. Several plants which may be easily reproduced from cuttings are:

- a) Coleus blumei: Colcus is an excellent plant for many uses in the classroom. It can be grown quite easily from seed or cuttings. Two of the main features of this plant are the wide variety of brightly coloured leaves and its square, rather than round, stems. Coleus seeds or plants are usually available in garden shops from April to July each year.
- b) Tradescantia: Tradescantia sp. or "wandering jew" occurs in several colour forms from green, to variegated to a deep magenta. It is because of its attractive foliage that the plant is popular as a house plant as well as for use in outdoor hanging baskets. These plants are easily grown from cuttings at any time of the year.
- c) Geraniums: Geranium cuttings should be started in early September for flowering plants the next spring (in time for Mother's Day). Several Geranium plants should be grown through the summer in order to provide a source of cuttings in the fall.
- d) Chrysanthemums: Fall blooming Chrysanthemums can be cut back after blooming and repotted in good soil. By January or February several new shoots should appear on the old plants. Cuttings made from these shoots should be healthy plants by the end of the school year.
- e) African Violets: Plants such as African Violets, Pepperomia and Begonias can be propagated through the use of leaf cuttings.

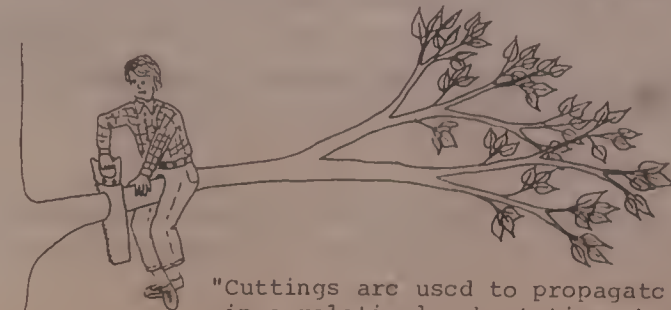
Cutting Methods

Cuttings are usually of three basic types: leaf cuttings, shoot cuttings and woody cuttings. Students should become familiar with some of the procedures involved in growing cuttings successfully before they attempt investigations on other plants.

Rooting Hormones

Root development can be accelerated in many cuttings through the use of rooting hormones. These hormones are readily available under a variety of brand names at most garden shops.

- a) Leaf Cuttings: Many house plants such as St. Paulia, Pepperomia, Rex Begonias or Sansevieria may be propagated by using a sharp knife to cut the leaf from the plant at the base of its stem. NOTE: When primary age children are working with cuttings it is probably best if the teacher demonstrates the necessary techniques first. Once leaves have been cut the end of the stem should be dipped in water and then in powdered rooting hormone. Prepared cuttings should be placed in small containers (see pg. 10) which are then filled with a mixture of clean sand and vermiculite or styro-foam. The sand mixture should be pressed down firmly around each cutting, thoroughly watered then kept moist cutting mixture holding the cut portions down with pebbles. Once students have had practise with some of the plants suggested, they should be encouraged to investigate the use of the technique on other plants. ↓



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b) Shoot Cuttings: Shoot cuttings are made from vigorously growing shoots of plants such as geraniums, Coleus, Begonias, Carnations, Chrysanthemums and roses. A half ripe, nonflowering shoot, about three inches in length is the most desirable. The shoots should be cut at the base of a node (point where leaves are given off). About 2/3 of the remaining leaves should be removed in order to reduce water loss and prevent rotting. Dip the ends of cuttings in water then hormone powder and place them in a sand vermiculite mixture similar to that used for leaf cuttings.

c) Woody Cuttings: Hardwood cuttings from mature stems are usually made in the fall. These cuttings can be made from a variety of plants including Roses, Forsythia, Grapes, Blueberries and Huckleberries. Stems about pencil thickness and 12" long are cut with pruning shears then bundled and buried outdoors about 2 feet deep in sand. In March or April these stems are dug up and planted outdoors in a moist sand soil.

2. Seedlings

When seedlings are to be grown in the classroom for a specific purpose such as Mother's Day flowers or a class vegetable garden, a few precautions should be taken to ensure the maximum success of the project. The following guidelines can be applied to any seed growing efforts but should not be strictly enforced in instances where students are experimenting with techniques and materials of their own design.

A. Materials Needed

a) Seed containers: Shallow pans, aluminum plates, T.V. dinner trays, styrofoam cups or other such containers are suitable as long as they are

pierced to provide good drainage at the bottom.

b) Soil mixture: Potting or garden soil mixed half and half with peat moss is an excellent starter mix for seedlings. Vermiculite, styrofoam shreds or finely ground up newspaper can be added to make sure that the soil is light and airy. Students who are experimenting with soils may wish to try several recipes for good seedling soils.

c) Disinfectant: Many small seedlings are susceptible to fungus attack and will be lost if precautions are not taken. Overwatering and poor ventilation encourage fungus attack and should be avoided. Most seeds which are purchased from garden shops or seed houses have been chemically treated for fungus prevention. If seedlings seem to die soon after germinating you can use household bleach as a fungus preventative as follows:

- i Mix a solution of 1 part bleach to 8 parts water.
- ii Place seeds in a cloth bag or wire strainer and stir them back and forth in the bleach solution several times.
- iii Remove the seeds immediately and shake off excess moisture.

d) Drainage material: Some gravel or bits of broken pottery should be available to provide additional drainage for the seed trays.

B. Planting Seedlings

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a) Place a 2 cm layer of gravel on the bottom of each seed tray then cover this with about 10 cm of firmly pressed down soil.

b) Water the soil thoroughly and allow it to stand for about 15 minutes before planting seeds.

c) Larger seeds may be planted in rows or other patterns while small seeds should be scattered over the surface of the container then covered with a very fine layer of moist soil. Seeds should be planted to a depth no greater than twice their diameter.

d) Once seeds have been planted the container should be covered with a board, glass plate or sheet of dark plastic to prevent them from drying out too rapidly. Be sure to leave an air space between the cover and the seed container for ventilation. (Most seeds germinate better in darkness so keep them covered or in a closet until the first shoots appear).

e) Have students check their seed trays and remove any excess moisture from the covering each day. If the soil has become too dry, seed trays should be watered by allowing them to sit in a pan of water for about 15 minutes.

f) As soon as the first green shoots are seen, the trays should be uncovered and placed near a window. Young seedlings will require some shading from bright sunlight. This may be accomplished by taping single sheets of newspaper to the window or simply by using venetian blinds.

C. Transplanting

Once seedlings have produced a second set of leaves they should be transplanted to a less crowded situation and provided with more room to grow. Seedlings should be carefully dug up using a fork or popsicle stick and handled

carefully by their leaves rather than the fragile stems. Transplant seedlings to containers which are at least 8 cm deep and have about 2 cm of gravel covered with 6 cm or more of soil mixture. Spacing will depend on the plants involved and students can experiment with different arrangements to see which works best. A good general rule to follow is: No more than one plant per "coffee cup" of soil.

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	RETURN JAN 21 '83
JUN 16 RETURN	DUE MAR 3 '83
	RETURN FEB 28 '83
RETURN APR 2	MAR 7 '84
RETURN MAY 20 '81	MAR 17 '84
	DUE EDUC MAR 27 '84
	DUE EDUC APR 04 '84
RETURN NOV 23 '81	APR 8 RETURN
	MAR 05 '85
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